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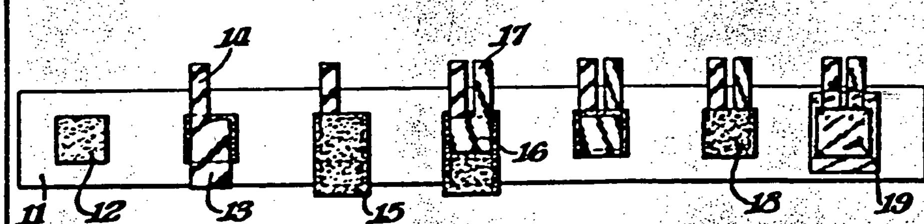
(54) **Sealed flat electrolytic capacitor and production thereof**

(57) A flat capacitor is manufactured by placing an anode foil (16) within a fold of spacer (15) that is within a folded cathode foil (13), impregnating the assembly with electrolyte, and then heat-sealing the assembly between layers of polymer element (19). The foils of polymer element (19). The foils have electrode tabs (17, 14) attached thereto that are spaced laterally from each other and extend beyond the same edges of the polymer element (19).

Fig. 1.



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SPECIFICATION

Sealed flat electrolytic capacit r and pr ducti n thereof

This invention relates to flat electrolytic capacitors and to the manufacture thereof.

There is an increasing demand for electrolytic capacitors with a low CV (Capacitance multiplied by Voltage) valus. This demand has been met by a variety of capacitors: subminiature wound aluminium electrolytic capacitors; solid electrolytic capacitors; and some plastics film, paper, and ceramic capacitors. Each type has certain advantages, for example, in terms of cost, size, form factor and electrical characteristics, but no one type offers all or a majority of the advantages or required characteristics.

We have now developed a process of manufacturing a sealed flat electrolytic capacitor in such a size and form as to give high component packaging density when used with circuit boards, the process being adapted for automation, thus reducing costs.

The process according to the invention comprises locating an anodized anode foil within a folded spacer located within a folded cathode foil, said anode and cathode foils each having an electrode tab attached thereto, impregnating the resulting unit with electrolyte, and encasing it in a heat-sealable polymer element with the electrode tabs extending beyond edges of the polymer element, and heat-sealing the polymer element around at least the periphery of the unit.

The present invention also comprises a flat electrolytic capacitor comprising an assembly of an anodized anode foil bearing an electrode tab, a cathode foil bearing an electrode tab, electrolyte in contact with the anode foil and the cathode foil, the anode foil being of substantially the same width and approximately one-half the length of the cathode foil, the anode foil being within a fold of spacer, the cathode foil being folded to overlie both sides of the anode foil and the spacer, the assembly being sealed between polymer layers, the tabs being laterally spaced from each other and extending beyond the edges of the polymer layers.

In general, the flat capacitors of this invention may be assembled on a continuous plastics strip that becomes one side of the final capacitor, or the units may be assembled continuously and placed on the plastics strip just before final sealing. In either case, the result is a flat electrolytic capacitor encased in a heat-sealable plastic with leads spaced for automatic insertion into circuit boards.

In order that the present invention may be more fully understood, embodiments thereof will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a series of steps in the process according to the present invention, and

Figure 2 shows another embodiment of the invention.

In the method shown in Figure 1, a plastics film strip 11 having a laminar heat-sensitive adhesive layer is first provided with a sheet f spacer paper 12. Over spacer paper 12 is placed etched cathode foil 13 with attached electrode tab 14. On top of foil 13, a second sheet of spacer paper 15 is placed, followed by etched anodized anode foil 16 with attached electrode tab 17. In the embodiment shown, the anode foil 16 is approximately one-half the length of cathode foil 13 and spacer paper 15. The excess cathode foil 13 and spacer paper 15 are folded back over anode foil 16. A third paper spacer 18 is placed over the assembly, and electrolyte (not shown) is applied to the foil and spacerassembly. A plastics film cover sheet 19 is placed over all, and the assembly is heat-sealed at least around the periphery thereof. Cathode and anode leads (not shown) are attached by known means to cathode electrode tab 14 and anode electrode tab 17, respectively.

The illustrated process lends itself to automation by using a continuous plastics film strip that is moved along the line from station to station for super-position of each succeeding layer at each succeeding station.

In another embodiment, the anode foil may be approximately one-half the length of the cathode foil and second spacer paper 15. Before adding the third spacer paper 18, excess cathode foil and the second spacer paper are folded over the anode foil. The process is completed as before.

Similarly, the first spacer paper may be the length of the cathode foil and second spacer paper, and all may be folded over the anode, eliminating the third spacer paper. The plastics strip may be twice the final width and it may be folded over the unit instead of using a second plastics strip prior to heat-sealing, thus eliminating the second strip and a seam on one side of the unit. Another variation is to space the units farther apart, cut them apart after impregnation, fold the plastics strip over from the side, and heat-seal.

Another way of automatically assembling the units is to preassemble the capacitors and then deposit them on adhesive-coated portions of the plastics strip and finally heat-sealing the units in plastics. This may be achieved using a paper spacer wider than the cathode foil, a continuous strip of etched cathode foil with electrode tabs attached and a continuous strip of etched and anodized anode foil with electrode tabs attached.

In the embodiment shown in Figure 2, as paper spacer 12 is unwound from a roll it is folded in half lengthwise. Etched cathode foil 13 with attached electrode tabs 14 is likewise unwound from a roll, folded in half lengthwise, and positioned inside folded paper spacer 12. Another paper spacer 15 is unwound from its supply roll, folded in half lengthwise, and positioned inside folded cathode foil 13. Another foil 16 with attached electrode tabs 17 is positioned inside folded paper spacer 15. Subsequently, the assembly is flattened and cut into individual capacitors before or after impregnation with an electrolyte. The individual units may be placed on a plastics strip which may be folded over to form an envelope or a second

cover strip may be used. The units are then heat sealed as above, and leads are attached.

Alternatively, the continuous anode foil strip might be inserted into folded paper spacer strip, in turn inserted into folded cathode foil strip that in turn is inserted into an outer folded paper strip and crimped, impregnated, separated into individual units, and heat sealed in plastics as above.

If more rigidity is desired, plastics grids, e.g. 10—20 mils (0.25-0.51 mm) thick, may be placed on the plastics strip, and the units placed in them. Other variations will be obvious to those skilled in the art.

The plastics strip is of thermoplastic polymer material; suitable commercially available thermoplastics include polyolefins, e.g. polyethylene or polypropylene, perfluoroethylene, polyvinylchloride, or polyester.

The process according to the invention is suitable for making capacitors, for example, of 0.5 to 1.5 inches (12.7 to 38.1 mm) by 0.75 to 1.5 inches (19.05 to 38.1 mm) by 0.1 inch (2.54 mm). The lead wire spacing for the smallest such capacitor is generally 0.2 inch (5.0 mm) with increments of 0.1 inch (2.54 mm) for the larger sizes.

A light weight capacitor is thus produced that takes up a minimum of board area and provides high component packaging density per board and for automatic insertion with conventional equipment.

CLAIMS

1. A process of manufacturing a sealed flat electrolytic capacitor, which comprises locating an anodized anode foil within a folded spacer located within a folded cathode foil, said anode and cathode foils each having an electrode tab attached thereto, impregnating the resulting unit with electrolyte, and encasing it in a heat-sealable polymer element with the electrode tabs extending beyond edges of the polymer element, and heat-sealing the polymer element around at least the periphery of the unit.

2. A process according to claim 1, in which the anode foil is approximately one-half the length of the cathode foil and of the spacer, and excess cathode foil and spacer are folded around th anode foil to locate the anode foil therewithin.

3. A process according to claim 1, in which the electrode tabs extend from the same edge of the polymer element.

4. A process according to claim 3, in which the edge is opposite the fold of the cathode foil and the spacer.

5. A process according to claim 1, in which a spacer is also placed between the foils and the polymer element before heat-sealing.

6. A flat electrolytic capacitor comprising an assembly of an anodized anode foil bearing an electrode tab, a cathode foil bearing an electrode tab, electrolyte in contact with the anode foil and the cathode foil, the anode foil being of substantially the same width and approximately one-half the length of the cathode foil, the anode foil being within a fold of spacer, the cathode foil being folded to overlie both sides of the anode foil and the spacer, the assembly being sealed between polymer layers, the tabs being laterally spaced from each other and extending beyond the edges of the polymer layers.

7. A process of manufacturing a sealed flat electrolytic capacitor, substantially as described herein with reference to Figure 1 or 2.

8. A flat electrolytic capacitor, substantially as described herein with reference to Figure 1 or 2.

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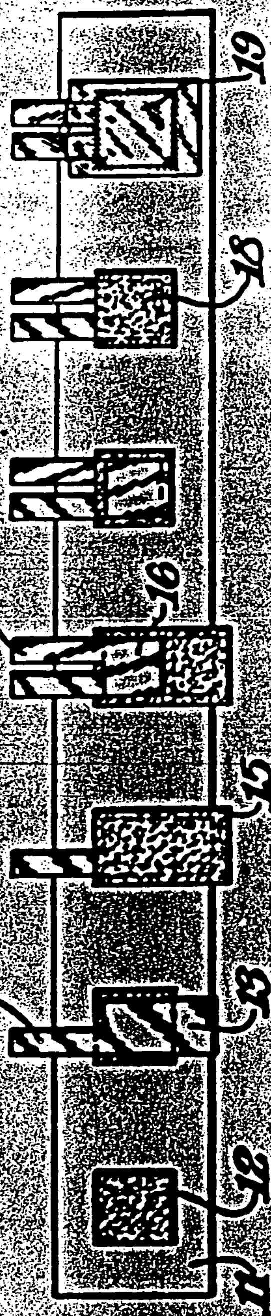

Fig. 1.

Fig. 2.